# First look at 3D Visual Alignment displays.

Produced 3D residuals with Sherry's SMT_align_it using input data /prj_root/809/b_1/smjt/zmumu_perf.dat, 200 events, tracks with $p_T$>5GeV/c, yielding 911 residuals.

Modified from Sherry's SMT_align_it to use all hits in track fit, rather than dropping one.

SMT_align_it produces output file data.dat with residuals, alignment hits, alignment tracks.

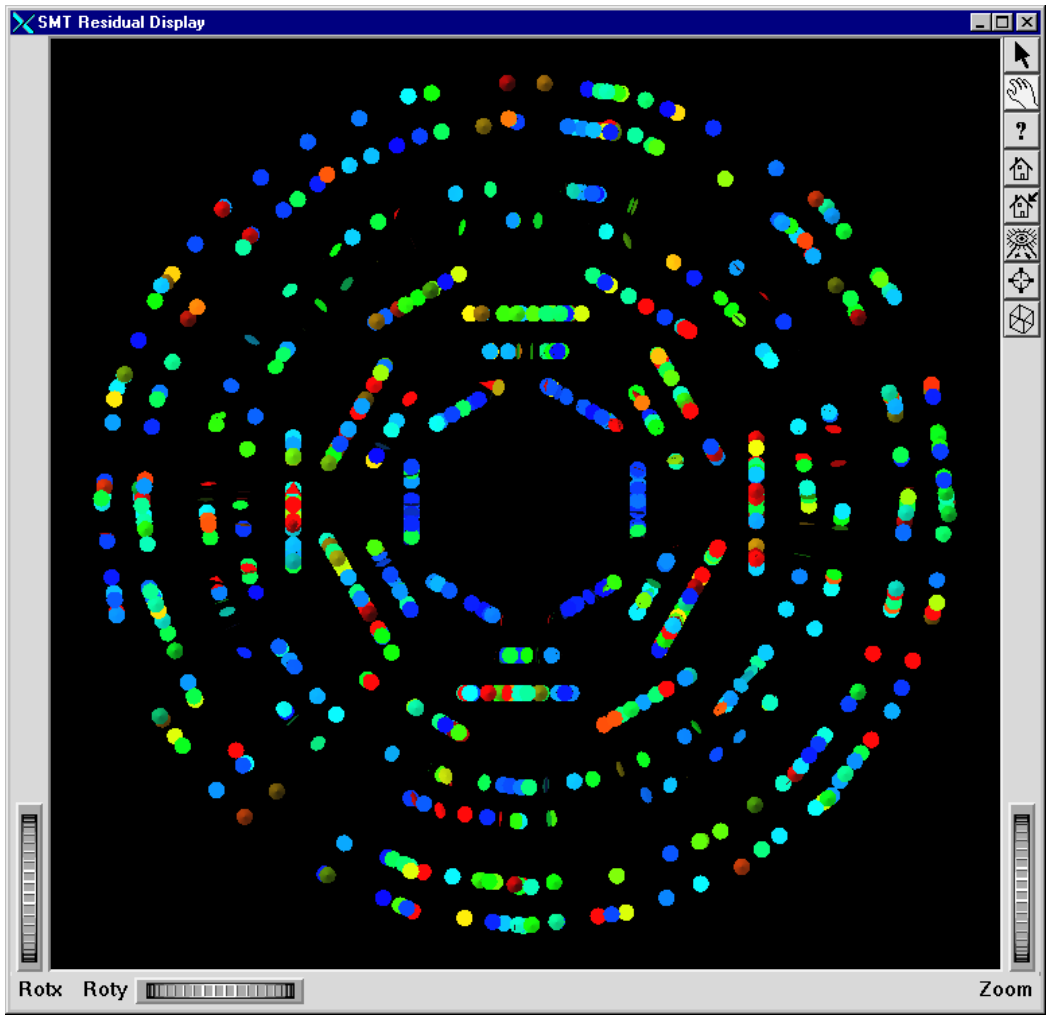
SMT_display_resid reads data.dat as input for the display.

Log file shows first few residuals:

```
SMTAlignmentEngine(constructor)
SMTBarrelEngine(constructor):
We are now in the ResidualField3D default constructor...
238
Adding residual field to display. Number of residuals: 238
get_resid gets vector of residuals with this many residuals: 238
measured vector[0] begin MLDGeneric 1 X 3 - formatted
   +0.654              -3.64               +9.09
end

difference vector[+0] begin MLDGeneric +1 X +3 - formatted
 -5.23e-05           -9.3e-06            +0.00124
end

chi[+0] +0.279
measured vector[+1] begin MLDGeneric +1 X +3 - formatted
   +0.815              -4.55               +10.3
end

difference vector[+1] begin MLDGeneric +1 X +3 - formatted
 +9.62e-05           +1.71e-05            +0.003
end

chi[+1] +0.328
```

# End view looking down the beam.

Residuals are represented by cones of fixed diameter pointed along the residual direction with height proportional to the residual magnitude, scaled up by a large factor to make them visible. In this case we see mostly the bases of cones, indicating that the residuals point mostly along the z axis.



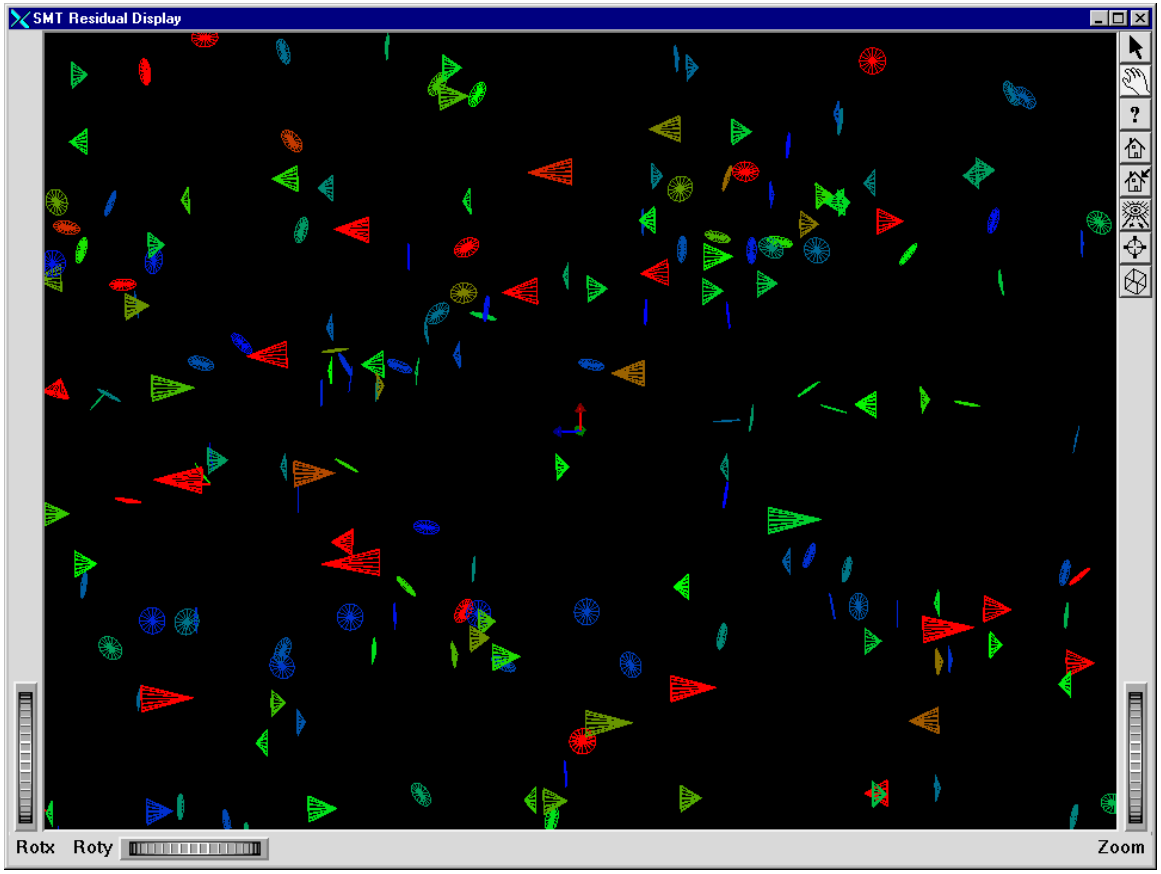

I suspect that Sherry is basing her 3D residuals on the point along the track which is closest to the hit based on $\chi^2$ rather than on the geometric "closest distance of approach." That is fine for the calculations because she uses the full error matrix. It may also be OK for visualization, but this needs more exploration.

Colors represent $\chi^2$.

# View looking down x axis at center of barrel, z axis to left.

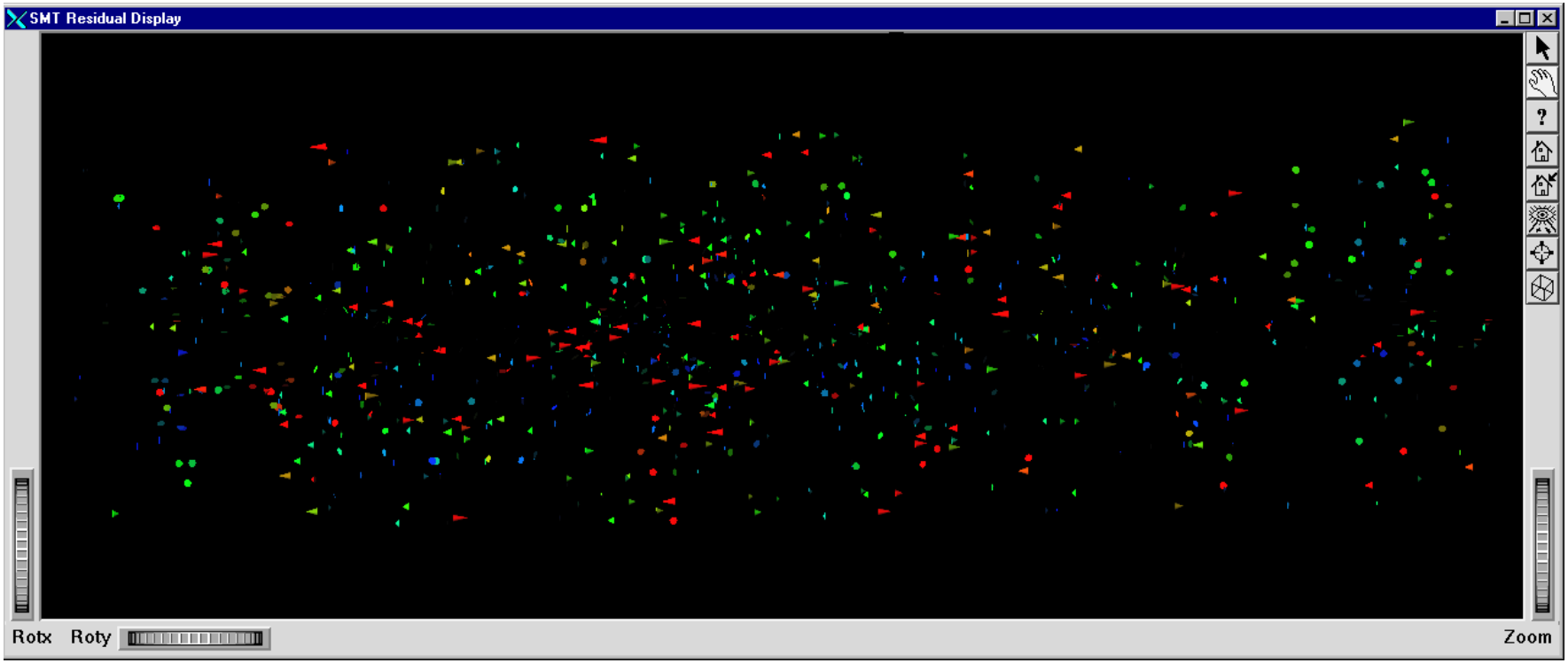
Cone bases have 2 mm radius and cone height is scaled up by a factor of 20 so largest residuals shown are about 500 microns along the z axis.

sqrt($\chi^2$) =0: blue, graded to 1: green, graded to 2: red. Above 2, pure red.



# View of entire 6 barrels looking down x axis, z axis to left.

No clear pattern of bad $\chi^2$ or large residuals though there is somewhat of an excess in barrel 4.



# View down x axis with z to left. Z component suppressed.

We see about half of the barrels. Residuals are scaled up by 200, but their z component is suppressed. The x&y residual components are small so most cones are short. We see them mostly as flattened disks. We barely see them at all for ladders parallel to the view plane, in other words, for ladders near y=0, because we are looking at the edge of the disk. These appear in a horizontal band across the center of the detector.